Book Review: Recovering the Machine's Enemies: Circularity, Emergence, Evolution, and Chance

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Emergence, Complexity, and Self-Organization: Precursors and Prototypes. Alicia Juarrero and Carl A. Rubino (Eds.). Exploring Complexity Book Series: Volume 4. (2008, Goodyear, AZ: ISCE Publishers.) $52.99, 247 pp.

> It's the mark of an educated man to look for precision in each class of things just so far as the nature of the subject admits.
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> Aristotle (Ethics)[1] [1, p. 1730]

This is an excellent collection of essays for all those challenged by the task of understanding complex phenomena. Current discussions on complexity and related ideas involve various concepts that can be interpreted in different ways, and that are thus often a source of confusion and vagueness. Reading the texts on the subject presented here is therefore a way of expanding our knowledge, of opening perspectives on controversial issues, and of analyzing current discussions through their historical conceptual ramifications and developments. There is no doubt that primary sources are essential to frame and to enlighten contemporary discussions.

From Immanuel Kant (1724–1804) to Ludwig von Bertalanffy (1901–1972), this anthology gathers 14 early studies. It contains many of the most important seminal works on complexity. It is preceded by a general introduction by the editors that summarizes the main lines of the approach. The editors focus in the first place on the mechanistic approach, and on the way in which a complex stance differs substantially from mechanism. The latter tends to view mechanical explanation as the only legitimate scientific explanation, not just in physics, but also in chemistry or biology. The main tenets of mechanistic explanation are efficient causation and the reduction of whole entities to their constituent, noninteractive physical components. This approach implies that entities, including complex ones, can only be viewed as mere aggregates of particles ruled by mechanical laws, and involves a radical rejection of an ontological status of emergent properties in complex phenomena. Accordingly, every scientific explanation of complex entities has to follow the ideal schema of mechanism in physics: determinism, deducibility, and predictability. This viewpoint on mechanism on the part of the editors, their rejection of the idea that reductionist mechanism is adequate to account for complex systems, makes the present work into something more than an anthology about "the emergence of emergence." It is this viewpoint that actually enables us to discern a clear thread binding the various articles together, notwithstanding their differences in relation to ontological and epistemological matters.

The articles can be divided into at least four groups, a division based on the way in which mechanism is criticized, undermined, or rejected. Firstly, Kant claims, in contrast to mechanical perspectives, that we need circular causality to adequately account for life. Secondly, British emergentism attempts to ground the ontological status of emergence in the interaction between components.

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1 The editors used this quotation to suggest that Aristotle's prophetic words can be extended to natural science [2, p. 8].

Thirdly, Bergson, Whitehead, and Smuts are "process thinkers," and consequently stress the evolutionary character of nature. Finally, Schrödinger, Poincaré, and Peirce use thermodynamics and chance to argue for the shortcomings of a deterministic mechanical perspective.

The "Analytic of Teleological Judgment" (1790) by Immanuel Kant inaugurates this compilation. For Kant, life witnesses of a particular kind of organization. Every part functions for the sake of the rest of the parts in the organism, and for the sake of the organism as a whole. Unlike a machine, an organism has formative power (self-propagating power). In this sense, organisms are both cause and effect of themselves. The causality to which life owes its origin is quite different from the mechanical idea of efficient causality. Circular causality is the only kind of causality capable of providing a proper account of life. Kant concludes that organisms are entities that cannot be objectively known purely on the basis of mechanical laws. Organisms have to be conceived as natural purposes, and require purpose as a regulative concept to guide our reason in every investigation of life.

A substantial section of the volume is devoted to what McLaughlin called "British Emergentism" [3]. "On the Composition of Causes" (1843) by John Stuart Mill (1806–1873), "The Order of Qualities" (1920) by Samuel Alexander (1859–1938), "Emergence" (1923) by C. Lloyd Morgan (1852–1936), and "Mechanism and Its Alternatives" (1925) by C.D. Broad (1887–1971) belong to the first articulated movement that explored emergence as an alternative to mechanism. Mill formulated the first crucial distinction between, on the one hand, phenomena in which the joint effect of several causes is just the additive resultant of their separate effects (e.g., a machine) and, on the other hand, the cases in which the joint effect is not given by the mere addition of the causes (e.g., life). Starting from this distinction, the emergentist program conceives of complex entities as discontinuous transitions of matter. For Alexander such transitions are finite material arrangements of absolute space-time. New arrangements bring about non-reducible qualities, none of which are exhibited by the basic component of the configuration. Both Alexander and Lloyd Morgan emphasize the creative character of emergent evolution. Nevertheless, Lloyd Morgan prefers a description of emergence in terms of relatedness. Complex entities have supervenient configurations with new relations among the constituents and other complex entities. Finally, C.D. Broad achieved the most mature treatment of emergence in this period. Starting from the opposition between emergentism and mechanism, Broad provides us with a justification of the ontological status of emergents and their relation with teleology and design.

British emergentism had its effects across the Atlantic. The US philosopher Arthur Lovejoy (1873–1962) embraced the ontological approach to emergentism that Broad explored previously. In "The Meaning of Emergence and Its Modes" (1926), Lovejoy discussed the emergence of consciousness and mind as one of the clearest examples of emergence in evolution. Thirty years later, in "The Concept of Emergence" (1956), the US philosophers Paul E. Meel (1920–2003) and Wilfrid Sellars (1912–1989) argued that the question of emergence should be answered in terms of observable phenomena and cannot be settled on a priori grounds.

Prediction, stability, and materialism are the main mechanical pillars that Alfred North Whitehead (1861–1947) and Henri Bergson (1859–1941) attack in "Science and the Modern World" and "The Evolution of Life—Mechanism and Teleology" (1911), respectively. Mechanism grounds prediction on the demand that no arbitrary breaks can be introduced in nature. Events are isolated in order to abstract the laws under which reality develops. However, this can be applied only to non-organic entities. Organisms are units of emergent value, which are not susceptible to being abstracted through laws. Therefore, ontological stability in organisms is an artificial result of the mechanical methodology. Whitehead and Bergson insist on the evolution of organisms not as a mere description of changes of reversible relations between portions of stable matter. Evolution is a permanent process of organic and creative change. No change can escape from its own history. Memory automatically shapes the present; it inherits a certain identity transmitted throughout a historical route of events and brings about the future.

Change is also the keystone for Jan C. Smuts (1870–1950). Like Whitehead and Bergson, Smuts supports, in "The Holistic Universe," a universe ontologically defined by change: A permanently changing universe evolves creatively through the generation of units of wholeness. Smuts rejects realist and idealist epistemologies. In his iconoclastic view, we find claims in favor of a science respectful of metaphysical concepts like emergence and a philosophy aware of the historical origin of reason.

Thermodynamics was used by Henri Poincaré (1854–1912) in order to show, in "Mechanism and Experiment" (1893), the empirical paradoxes of the mechanical program. Reversibility as a necessary consequence of mechanics is not compatible with experimental facts. Poincaré calls the entire paradigm of "physical law" and "legitimate explanation" into question. However, it is Charles S. Peirce (1839–1914) who formulated the most complete critique against mechanism, based on an analysis of the explanation of thermodynamics. "Design and Change" (1883) refuses radically the main assumption of determinism. Science traditionally considers that if a question is sufficiently investigated by reasoning and observing, it receives a proper and definitive answer. "Every event has a cause"[2] has been the battle cry of scientific determinism. In contrast, Peirce claims that uncertainty and chance (in the sense of absence of cause) are underestimated agents of empirical research. Peirce thinks that the deterministic assumption in science extends itself to another fallacy: scientific laws. Even basic thermodynamic "laws" have deterministic sense only in terms of statistical value. Peirce went further: Unlike mechanical force, chance is not dissipative, but concentrative. Chance produces uniformity through evolution acting against the dissipation of mechanical forces. Life could be just a uniformity resulting from chance. Erwin Schrödinger, in "Order, Disorder and Entropy," apparently suggested something similar. Even if dissipation in the long run promotes a non-ordered universe, some transient organized states of order (e.g., life) can postpone the decay into the inert state of equilibrium. Life would be an entity able to maintain itself through the consumption of negative entropy.

Significantly, the compilation ends with the influential work "An Outline of General System Theory" (1950) by Ludwig von Bertalanffy. Maybe because of his ample experience in biological problems, Bertalanffy was the first to create a formal system to analyze complex phenomena in practice. His theory of systems established the mathematical basis to study hierarchical systems composed of different levels of interdependent causes. He understood complex phenomena as partially mechanical systems, at the most. Individual wholeness is always resisting complete mechanization. Organisms are characterized by stability and equifinality, the latter referring to the capacity of the organism to reach the same end from very different starting points. Bertalanffy even suggests several scientific examples as applications of his general theory of systems.

We think this anthology paves the way to situate many important current and future controversies in relation to complexity. Important unsettled issues such as the plausibility of downward causation in emergence, or the role of determinism and law in the so-called "special sciences," depend on our capacity to understand properly such questions as those dealt with here. To understand the original meaning of these questions is a necessary step in such a task. Certainly, the reader of this anthology will find a stimulating challenge to the pervasive mechanical explanatory paradigm characteristic of large parts of our scientific worldview.

References

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3. McLaughlin, B. P. (1992). The rise and fall of British emergentism. In A. Beckermann, H. Flohr, & J. Kim (Eds.), *Emergence or reduction? Essays on the prospects of nonreductive physicalism* (pp. 49–93). Berlin: Walter de Gruyte.

2 For Peirce this is one of the main axioms that should be called into question.